Routine Imaging after Operatively Repaired Distal Radius and Scaphoid Fractures: A Survey of Hand Surgeons

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Abstract

Background There is currently no standard of care for imaging after hand and upper-extremity procedures, and current imaging practices have not been characterized.

Questions/Purposes To characterize current imaging practices and to compare those practices to the best available evidence.

Patients and Methods A survey was distributed to attending-level surgeons at a regional hand and upper-extremity surgery conference in the United States in 2013. 40 out of 75 surgeons completed the survey (53%).

Results All results are presented for distal radius and scaphoid fractures, respectively. There was a high degree of variability between respondents in the number of radiographic series routinely ordered during follow-up of asymptomatic patients, with the number of series ranging from 1–6 and 1–6. On average, respondents did not order an excessive number of follow-up radiographs for asymptomatic patients, with means ($\pm$ standard deviations) of 2.6 $\pm$ 1.0 and 3.3 $\pm$ 1.2 radiographic series. Radiographic series were taken at only 74% and 81% of postoperative visits with asymptomatic patients. Only 10% and 8% of respondents felt it was acceptable medical practice to save costs by ordering postoperative radiographs only when patients are symptomatic.

Conclusions Among a sample of 40 fellowship-trained hand surgeons, these findings demonstrate a high degree of variability in number of radiographs obtained after operative repair of distal radius and scaphoid fractures. On average, respondents were relatively efficient with respect to total number of postoperative radiographs ordered.

Level of Evidence Diagnostic study, level IV.

Keywords

- distal radius fracture
- scaphoid fracture
- scaphoid stability
- internal fixation
- wrist
- postoperative radiography

Imaging contributes substantially to the rising cost of health care.[1] Among surgical specialists, orthopaedic surgeons order a particularly high volume of imaging. Radiographic series are regularly taken during the initial evaluation of a patient, during preoperative planning, while the operation is under way, immediately after the operation, and at intervals throughout postoperative follow-up. In addition to the financial burden, imaging is associated with patient and staff time and exposure to radiation.

Several studies have recently been conducted based on a common premise: All routine postoperative radiography after orthopaedic procedures should have clinical utility that can be clearly demonstrated. Such studies have investigated immediate postoperative radiography (in the post-anesthesia care unit [PACU])[2,3] and postoperative follow-up radiography (in the outpatient clinic).[4–6] Such studies have been conducted in spine,[2,6] total joint arthroplasty,[3,4] and orthopaedic trauma.[5] These studies have all drawn similar

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conclusions: They find little support for routine postoperative radiography, and they recommend that postoperative radiography be minimized and/or used only for patients with signs or symptoms of concern for an abnormal postoperative course.

In the study regarding follow-up imaging, Ghattas et al studied follow-up imaging in the postoperative management of fractures.[5] They examined the radiographs of 200 consecutive patients taken at the initial postoperative visit after operative management of an array of fractures throughout the body. Fifteen (7.5%) of 200 fractures in 171 patients had a clinical indication for a radiograph because of an abnormal physical examination finding or history of additional trauma. Three (1.5%) of these fractures had a deviation from standard postoperative care; this deviation was a change in postoperative care on the basis of the patient history and physical examination rather than radiographs. The authors found that for only one patient was a change visible between the PACU radiograph and the postoperative follow-up radiograph; yet, even for this patient, there was no resulting change in clinical management. The authors concluded that routine postoperative imaging at the initial visit after operative management of fractures has low clinical utility and could be discontinued. Similarly, Chaudhry et al studied post-splinting radiographs in minimally displaced fractures and found that post-splinting radiographs of minimally displaced or nondisplaced fractures that do not undergo manipulation before/during immobilization do not provide helpful information but do lead to increased health care costs, radiation exposure, and emergency room waits.[7] They concluded that routine performance of post-splinting radiography in these cases should be discouraged.

Despite the significance of routine postoperative radiography after hand and upper-extremity procedures in terms of cost, time, and radiation exposure, and despite the controversy regarding the utility of routine radiography raised by studies such as those of Ghattas et al and Chaudhry et al, no authors have characterized current imaging practices, compared those practices with the available evidence (e.g., Ghattas et al), or worked toward establishing a standard of care.

This study identifies current postoperative imaging practices among a sample of United States hand and upper-extremity surgeons with respect to two common procedures in hand and upper-extremity surgery: operative repair of distal radius fractures and operative repair of scaphoid fractures. First, we characterize imaging practices in the PACU. Second, we characterize imaging practices during outpatient postoperative follow-up. Third, we characterize the willingness of respondents to decrease their volume of postoperative imaging to save costs.

Materials and Methods

A survey was developed to characterize the practices of hand and upper-extremity surgeons regarding postoperative imaging for operatively repaired distal radius and scaphoid fractures. The survey asked each of the following questions first for operative repair of distal radius fractures and second for operative repair of scaphoid fractures. "Do you routinely order images to be taken portably in the recovery room?" to which participants were allowed to answer "Yes" or "No"; "At what postoperative time points do you routinely follow asymptomatic patients with office visits?" and "At what postoperative time points do you routinely follow asymptomatic patients with radiographic series?" to each of which participants were allowed to answer "1 week," "2 weeks," "4 weeks," "6 weeks," "2 months," "3 months," "4 months," 6 months," and/or "12 months"; "What views are routinely part of these radiographic series?" to which participants were allowed to answer "AP," "Lateral," "Oblique," and/or "Navicular" ("Navicular" was listed as a response choice only for scaphoid fractures); and "Do you think it is acceptable medical practice to save costs by ordering postoperative radiographs only when patients are symptomatic?" to which participants were allowed to answer "Yes" or "No."

The survey also asked participants to estimate how many distal radius fractures and how many scaphoid fractures they operatively repair each year; how many years they have been in practice; whether they were trained as orthopaedic,

Table 1 Participant demographics

	Percent[a]
Residency type	
Orthopaedic surgery	80%
Plastic surgery	15%
Other surgery	5%
Hand and/or upper-extremity surgery fellowship	
Not completed	0%
Completed	100%
Practice duration	
0 to 9 years	21%
10 to 19 years	23%
20 to 29 years	41%
30 or more years	15%
Practice type	
Private	57%
Academic	43%
Number of operatively managed distal radius fractures per year	
1 to 19	23%
20 to 39	52%
40 or more	25%
Number of operatively managed scaphoid fractures per year	
1 to 9	45%
10 to 19	42%
20 or more	13%

[a]Each section sums to 100%.

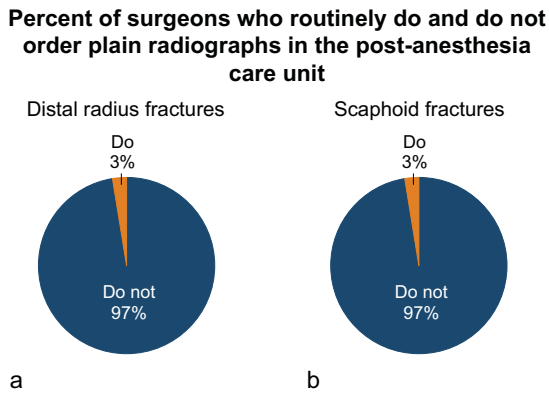

Fig. 1 Percent of respondents who routinely do and do not order plain radiographs in the post-anesthesia care unit. (**a**) After operatively repaired distal radius fractures. (**b**) After operatively repaired scaphoid fractures.

plastic, or other type of surgeons; whether they completed a fellowship in hand and/or upper-extremity surgery; and whether their practice is private or academic.

The survey was distributed to all attending hand and upper-extremity surgeons at the 2013 annual New England Hand Society meeting (Sturbridge, MA, December, 2013). Surveys were collected before surgeons left the meeting. Of the 75 attending hand and upper-extremity surgeons present, 40 returned the survey (53%). The demographics of these surgeons are depicted in ►**Table 1**. Most had completed a residency in orthopaedic surgery (80%), while minorities had completed residencies in plastic surgery (15%) or another surgical field (5%). All participants had gone on to complete a hand and/or upper-extremity surgery fellowship. Average practice duration was 19 years (median 20, range 1 to 47). There were both private and academic surgeons (57% versus 43%). Each year, participants reported operatively repairing a mean of 30 distal radius fractures (median 25, range 1–120) and 11 scaphoid fractures (median 10, range 3–40).

STATA version 13 (StataCorp, LP, College Station, Texas) was used for analysis. Descriptive statistics were used. Additionally, respondents were categorized as routinely following asymptomatic patients for 3 or fewer months versus 4 or more months, and a *t*-test was used to test whether the average number of radiographic series taken differed between these two groups. Our institutional review board approved this study.

Results

All results are given for distal radius and scaphoid fractures, respectively.

►**Fig. 1** depicts routine imaging practices in the PACU. Only 3% and 3% of respondents routinely ordered plain radiographs in the PACU.

►**Figs. 2–6** depict routine imaging practices for asymptomatic patients during postoperative outpatient follow-up. There was a high degree of variability between respondents in the number of radiographic series routinely ordered for asympatomatic patients during follow-up, with the number of series ranging from 1–6 and 1–6 (►**Fig. 2**). Five and 3 respondents ordered just one radiographic series, 12 and 7 ordered two radiographic series, and 23 and 30 ordered three or more radiographic series. On average, respondents did not order an excessive number of follow-up radiographs for asymptomatic patients, with means (± standard deviations) of 2.6 ± 1.0 and 3.3 ± 1.2 follow-up series. The average numbers of radiographic series taken by respondents who followed asymptomatic patients for 3 or fewer months were 2.4 and 2.8. The average numbers of radiographic series taken by respondents that followed asymptomatic patients for 4 or more months were 3.6 and 4.0. These were both statistically significant differences (2.4 versus 3.6, $p = 0.006$; 2.8 versus 4.0, $p < 0.001$). Radiographic series were taken at only 74% and 81% of follow-up visits for asymptomatic patients (►**Fig. 3**). There was also variability in imaging practices at the first postoperative visit, with only 80% and 77% routinely

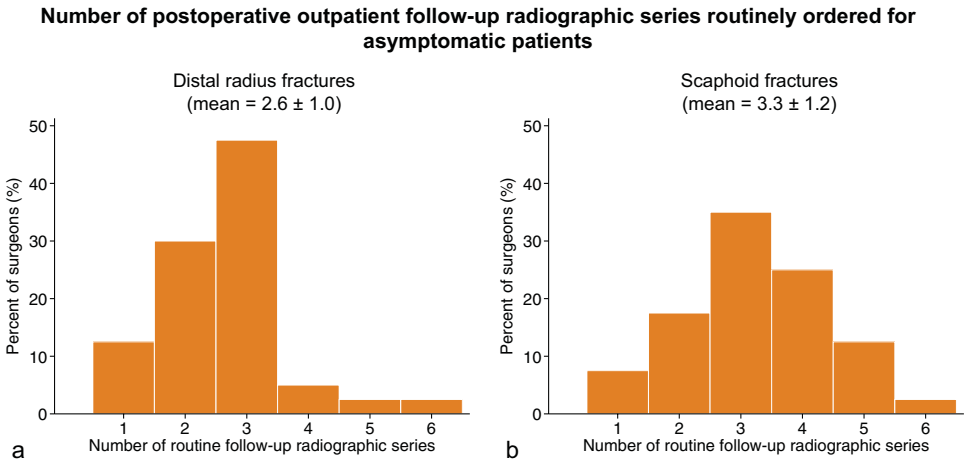

Fig. 2 Number of routine postoperative outpatient follow-up images routinely ordered for asympatomatic patients. (**a**) After operatively repaired distal radius fractures. (**b**) After operatively repaired scaphoid fractures.

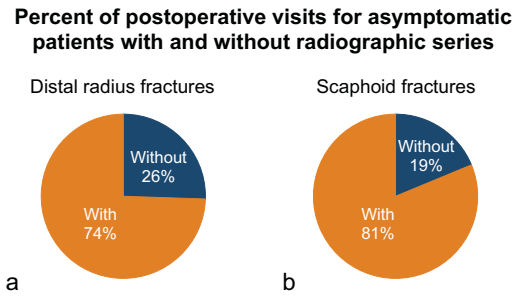

Fig. 3 Percent of postoperative visits for asymptomatic patients with and without radiographic series. (**a**) After operatively repaired distal radius fractures. (**b**) After operatively repaired scaphoid fractures.

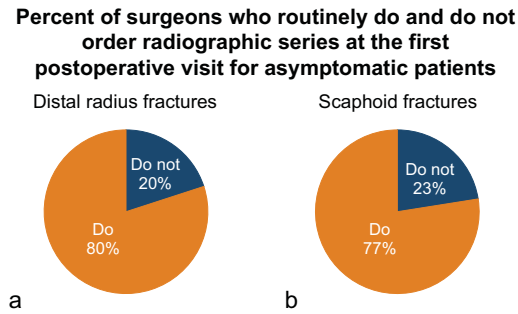

Fig. 4 Percent of respondents who routinely do and do not order radiographic series at the first postoperative visit for asymptomatic patients. (**a**) After operatively repaired distal radius fractures. (**b**) After operatively repaired scaphoid fractures.

ordering radiographic series at the first postoperative visit for asymptomatic patients (►**Fig. 4**). ►**Fig. 5** depicts the duration of routine postoperative follow-up for asymptomatic patients, which varied substantially between surgeons. The mean times (± standard deviations) for which surgeons routinely followed asymptomatic patients with office visits were 3.4 ± 2.4 and 4.3 ± 2.6 months. It is of note that only 25% of respondents were following distal radius fractures at 4 months, as compared with over 50% who were still following scaphoid fractures at 4 months. The mean times for which surgeons routinely followed asymptomatic patients with radiography were 2.9 ± 2.4 and 4.0 ± 2.7 months. ►**Fig. 6** shows which views were routinely ordered as part of postoperative follow-up series for asymptomatic patients; it demonstrates variability with respect to the ordering of oblique views for distal radius fractures and both oblique and navicular views for scaphoid fractures.

Finally, ►**Fig. 7** shows how respondents answered the question "Do you think it is acceptable medical practice to save costs by ordering postoperative radiographs only when patients are symptomatic?" To this question, 90% and 92% of respondents answered "No," while only 10% and 8% answered "Yes."

Discussion

Imaging after operative repair of orthopaedic trauma to the hand and upper-extremity contributes substantially to health care costs. However, evidence supporting the utility of this imaging is lacking. There is currently no standard of care for imaging after hand and upper-extremity procedures, and current imaging practices have not been characterized. This study characterizes routine postoperative imaging practices after two common hand and upper-extremity procedures and compares those practices to the best available evidence.

This study does have limitations. The major limitation is the small sample size, which limits the ability of the study to be used to draw firm, generalizable conclusions. Also, there may have been sampling bias impacting the ability of our study to represent the true population of hand and upper-extremity surgeons. Specifically, this population of hand and upper-extremity surgeons may have a geographical bias toward the geographic area in which the survey was administered. However, prior, similar studies have not shown any association between geographic location and imaging practices.[8,9] Another limitation is that this data, which was based on self-report, may not be as reliable as data collected directly from a large series of hospital systems or physician groups or data extracted from a review of a series of surgeons' records. Because these data are based on self-report, there is the significant potential that errors in surgeons' memories and estimations could have biased results. Another method would have been to conduct an analysis of surgeons' actual medical records; however, because we were striving to capture a high degree of institutional and practice diversity, this would have

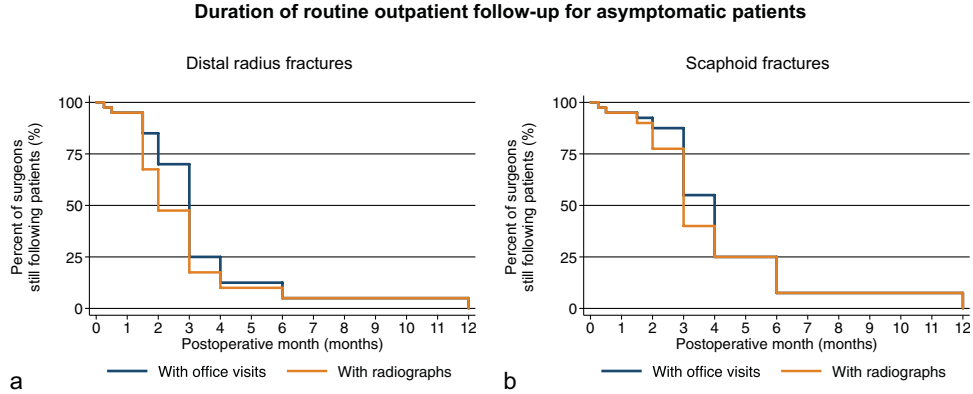

Fig. 5 Duration of routine outpatient follow-up for asympatomatic patients. (**a**) After operatively repaired distal radius fractures. (**b**) After operatively repaired scaphoid fractures.

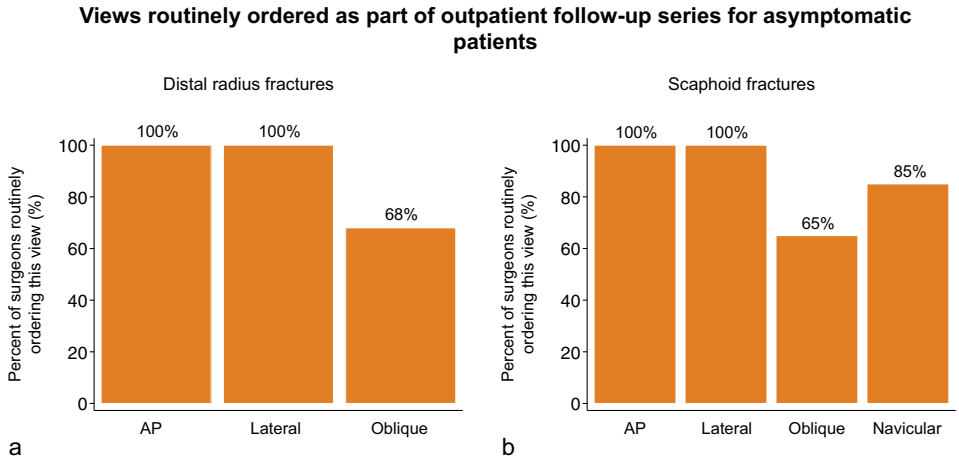

Fig. 6 Views routinely ordered as part of follow-up series for asympatomatic patients. (**a**) After operatively repaired distal radius fractures. (**b**) After operatively repaired scaphoid fractures.

required institutional review board approval at a very large number of institutions and likely would have led to a much lower rate of inclusion, introducing another important type of bias. Finally, the survey did not differentiate between different subtypes of distal radius and scaphoid fractures (fracture site, type, severity, etc.), which may require different durations of follow-up and/or different numbers of postoperative radiographic series.

The data presented here show that of the 40 respondents, only two routinely order radiography in the PACU. No studies have examined the utility of radiography in the PACU specifically after hand and upper-extremity procedures; however, studies have suggested that PACU radiography has little utility in other areas of orthopaedics.[2,3] Although our study did not ask respondents about their practices regarding post-splinting radiographs of minimally displaced fractures, it is worthwhile to note that there has been some recent investigation into this topic. Chaudhry et al[7] found that post-splinting radiographs of nondisplaced/minimally displaced fractures that do not undergo manipulation during or before immobilization do not have clinical utility but do increase costs, wait times, and radiation exposure. They concluded that post-splinting radiographs in these cases could be forgone. While this is a different type of imaging than the PACU imaging referenced by our survey, their findings are in line with the literature just mentioned regarding imaging in the PACU in other areas of orthopaedics. Our survey did not characterize routine imaging practices after nonoperatively managed fractures, and as a result this is potentially an area for future research.

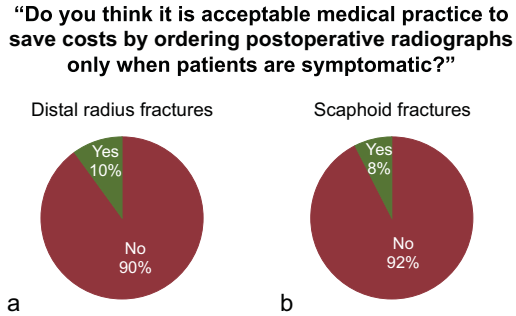

Fig. 7 "Do you think it is acceptable medical practice to save costs by ordering postoperative radiographs only when patients are sympatomatic?" (**a**) After operatively repaired distal radius fractures. (**b**) After operatively repaired scaphoid fractures.

Among the 40 respondents, radiographs were not ordered at all postoperative visits with asymptomatic patients (at only about three quarters of visits for both types of fractures). On average, respondents ordered only 2.6 follow-up series after distal radius fractures and 3.3 follow-up series after scaphoid fractures. Respondents who followed patients for shorter durations ordered fewer radiographs, and respondents who followed patients for longer durations ordered more radiographs. Respondents ordering fewer postoperative series could potentially be missing important postoperative events. Respondents ordering more postoperative series could potentially be overusing health care resources, wasting patient and surgeon time, and exposing patients and staff to excess radiation. As we have noted however, there are no data to support or refute this notion with regards to distal radius fractures and scaphoid fractures. These findings should be interpreted in the context of the recent studies that have demonstrated little or no utility for outpatient follow-up imaging in orthopaedics.[4–6] Of these studies, however, the only study that included hand and upper-extremity procedures was that by Ghattas et al.[5] However, this single study is lacking in its generalizability to hand and upper-extremity fractures: First, the study was not specific to hand and upper-extremity fractures: only 62 of 200 cases involved the hand and upper-extremity. Second, among these, only a fraction involved the distal radius or wrist. In this context, we propose that future studies should examine the utility of postoperative radiography after the various specific hand and upper-extremity procedures. These studies should focus on the utility at each of several specific postoperative time points, including, for example, the first, second, and third postoperative visits, conducted at, for example, 2, 4, and 8 weeks. Such

studies, if done carefully and with sufficient sample size for each fracture type, could play an important role in increasing the efficiency of healthcare resource allocation.

In conclusion, among a sample of 40 respondents, we demonstrate a high degree of variability in routine imaging practices after operative repair of distal radius and scaphoid fractures. Future work should test for the utility of postoperative imaging after specific hand and upper-extremity procedures as a means of beginning to grow the evidence base for this important practice.

Ethical Approval

The study was approved by our institutional review board.

Conflict of Interest

None

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